Renesas VP User Manual

The Simulation Site for Renesas Power MOSFETs

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2013.07

Overview

Renesas VP stands for “Renesas Virtual Power Lab.” and it is the site to simulate the power MOSFET operations of synchronous-rectified buck converters.

This site enables to calculate a waveform of buck converters or a loss of power MOSFETs of the power supply in a board around MCUs or SoCs such as POL. Therefore you can select suitable power MOSFETs when you start to design, and also it supports to speed up the evaluation.

Before Use

The registration to MyRenesas is necessary to use this site.

When you register for the first time, please enter your information in the registration page and confirm the checked Renesas VP in the content subscription page. You can access Renesas VP from your profile page of MyRenesas or logos/banners on our website after you have completed the registration.

If you are already MyRenesas member, please edit your content subscription and add this service.

This site consists of two sections. One is ACTIVE DATASHEET to simulate the characteristic of power MOSFET itself, the other one is BUCK DESIGNER to simulate the operation of buck converters in a model circuit.

And the viewer with common functions for a simulated graph allows to scale, move and read the value by its marker. Please refer to the help in a viewer for further information.

The target product is mainly the 10th power MOSFETs and later, furthermore, it will be expanded by adding newly-developed products. (There are some exceptions.)

Precautions

- Although the simulation result was confirmed whether it fits an observation result on our test board, it may not get the same results depending on your implementation conditions. Therefore please check the compatibility with customer’s board by adjusting setup conditions or parameters of a model circuit. And this will help to check which parameter works for interested characteristics of customer.
- Please use SWITCHING CIRCUIT that simulates only a switching part in view of detailed parameters such as parasitic impedance of boards to check switching a waveform, meanwhile, use SYSTEM SCHEMATIC that simulates the whole circuit, although detailed parameters are omitted, to check loop gains.
- The downloadable simulation tool for off-line fulfils its original functions when a downloaded circuit schematic on this site is combined with Renesas power MOSFETs. Please note that it does not fulfill one in case of other combinations by using other manufacturer’s circuit schematics or power MOSFETs.
- Please check the latest product status of Power MOSFETs on our website.
- If there is no action for over half an hour during simulations, the system makes a time-out error.
- The specifications in this system are subject to change without notice.

Contact

Pease contact Renesas sales offices in your region or use the following contact form.

Renesas Electronics Corporation; Customer support contact form http://www.renesas.com/contact/

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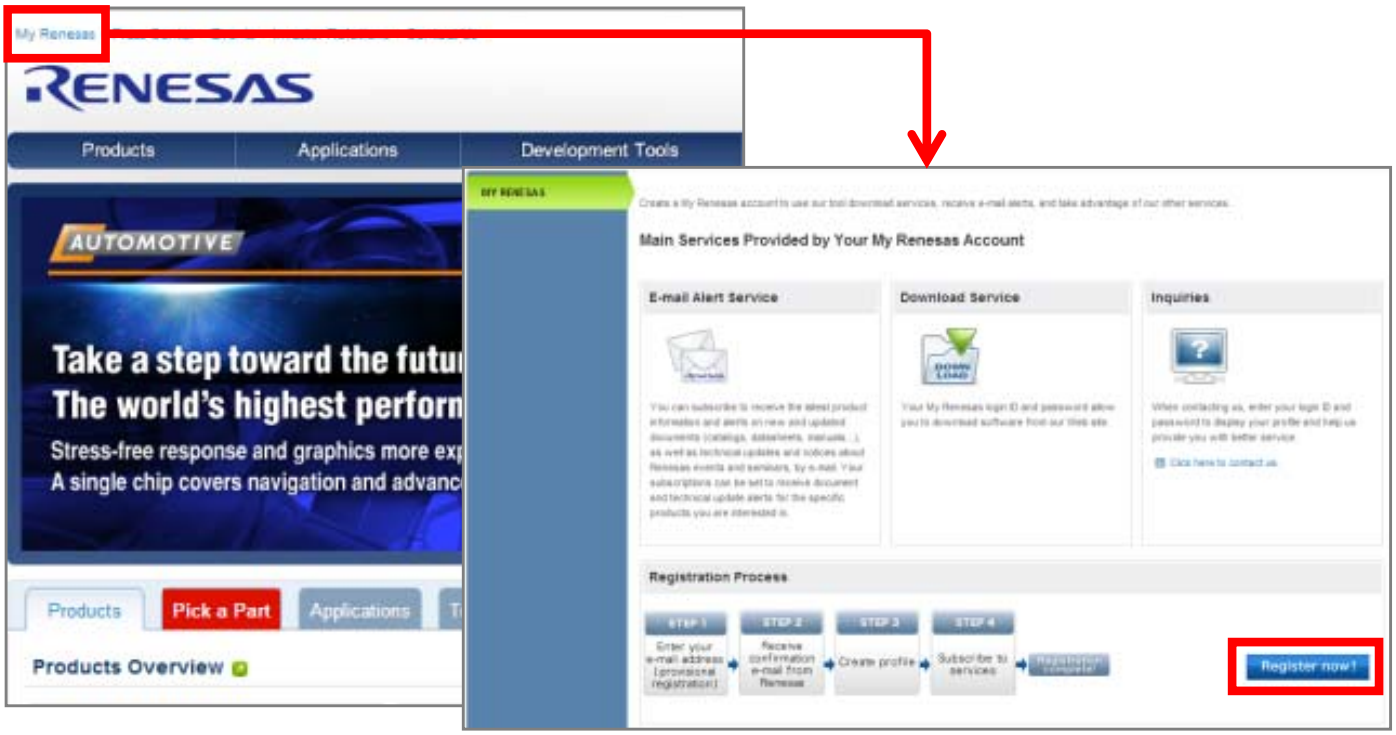
1. User Registration

The registration to MyRenesas is necessary to use Renesas VP.

MyRenesas is a subscription service provides convenient e-mail updates and additional supports such as tool download. And Renesas VP is provided as one of its premium services. Therefore please confirm the checked “Renesas VP” in the premium service when you register and set up your subscription alerts.

If you are already MyRenesas member, you need to edit your content subscription and add this service after logging in.

Renesas website



1.1. New Registration

(1) Enter you name and e-mail address. (Provisional registration)

(2) Receive confirmation e-mail and click the link.

(3) Create your profile.

(4) Subscribe to services. (Registration complete)

1.2. Edit Subscriptions

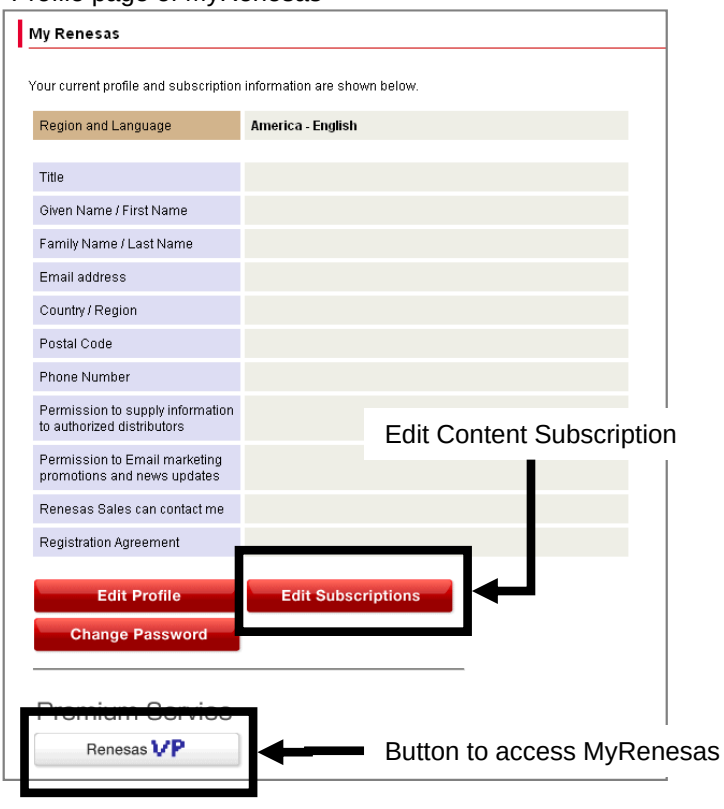
(1) Login to MyRenesas

(2) Click “Edit Subscriptions” in your profile page.

(3) Add a check to “Renesas VP” in subscription page.

(4) Click “Next”, and your profile page will be appeared again. (Change complete)

Profile page of MyRenesas

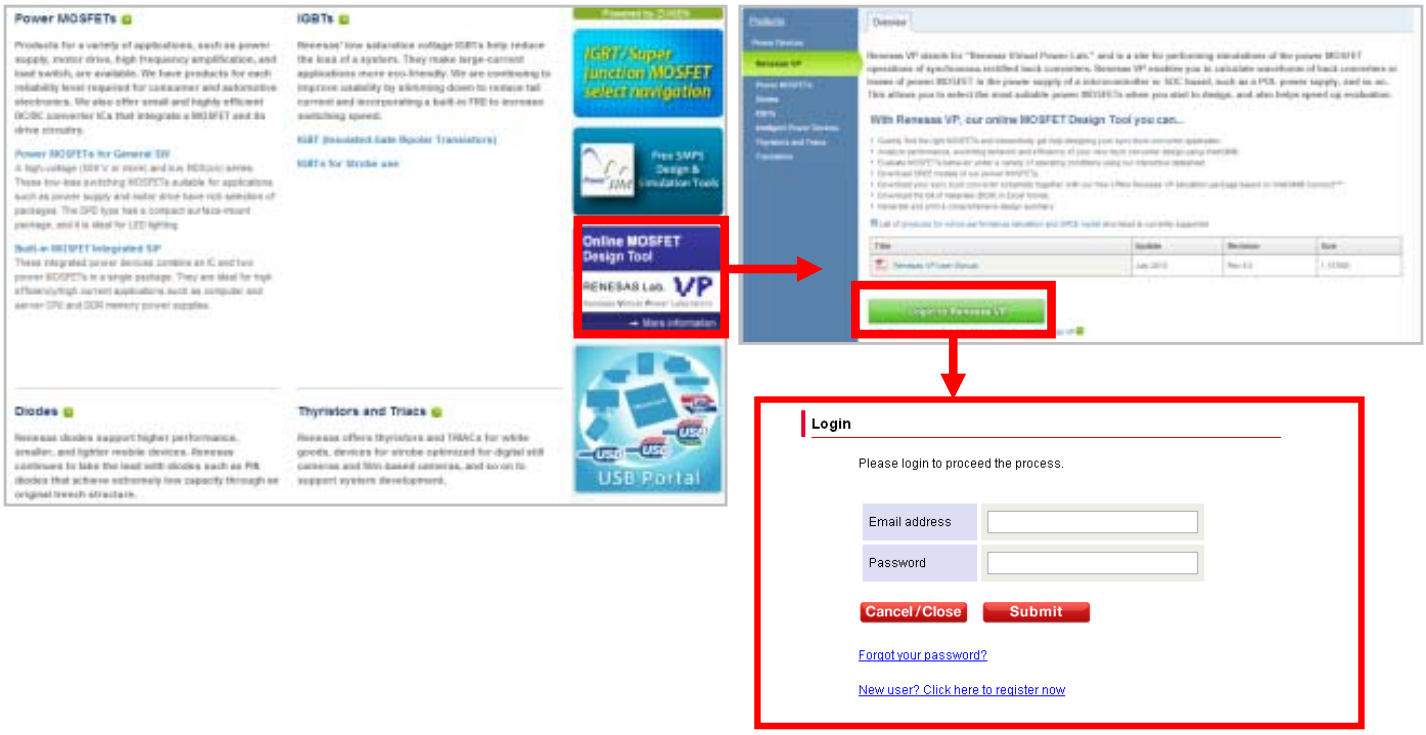


2. Login

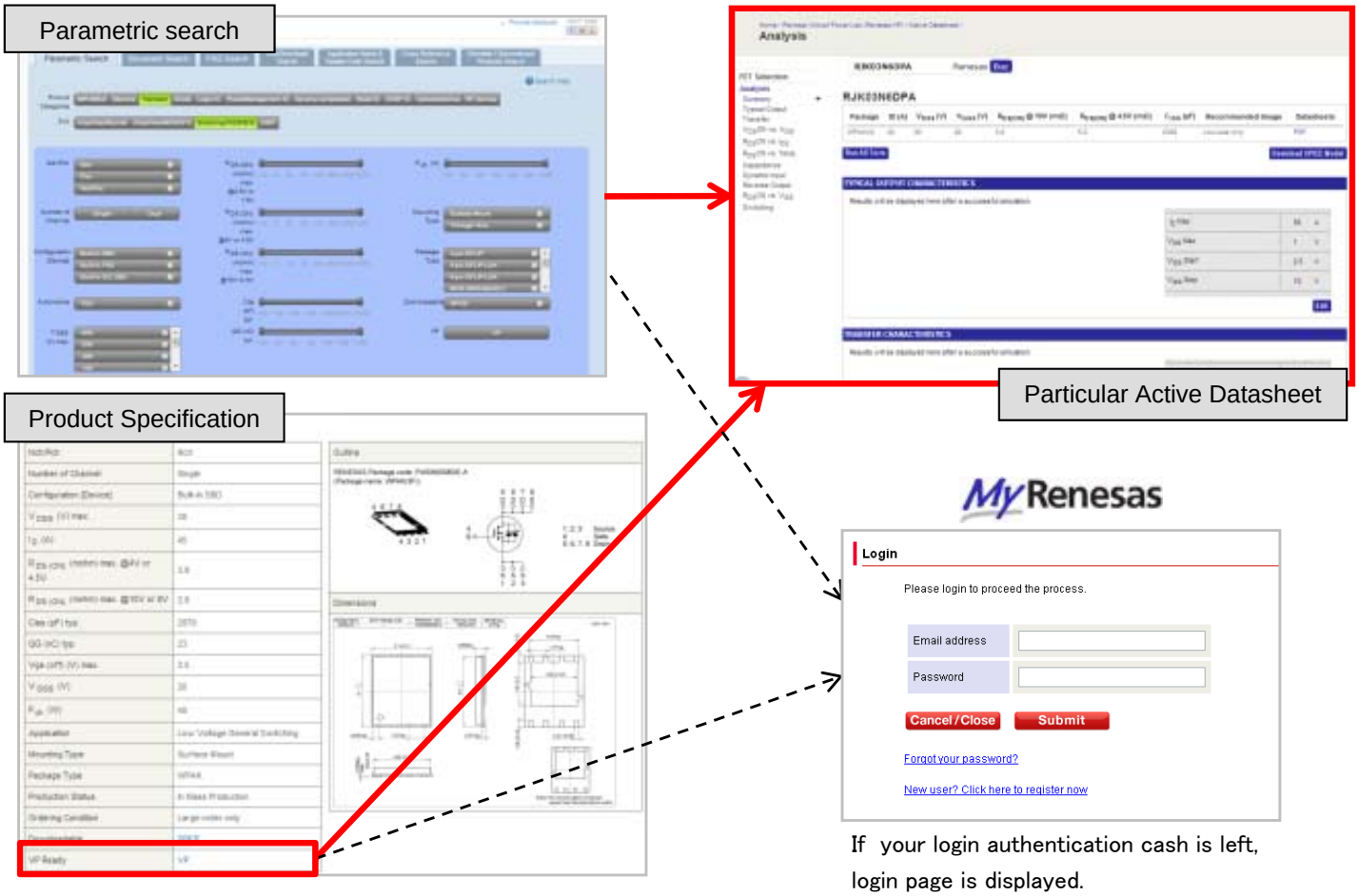
Click the banners or logos of Renesas VP on the power MOSFET related pages of Renesas website or visit http://www.renesas.com/vp directly.

Of course, you can access from the profile page of MyRenesas.

Ex. Power Devices category page



Additionally, it allows to access directly particular Active Datasheet pages from parametric search and product specification pages.



3. Landing Page

This is the first page of Renesas VP. Two menus and outlines are described.

ACTIVE DATASHEET

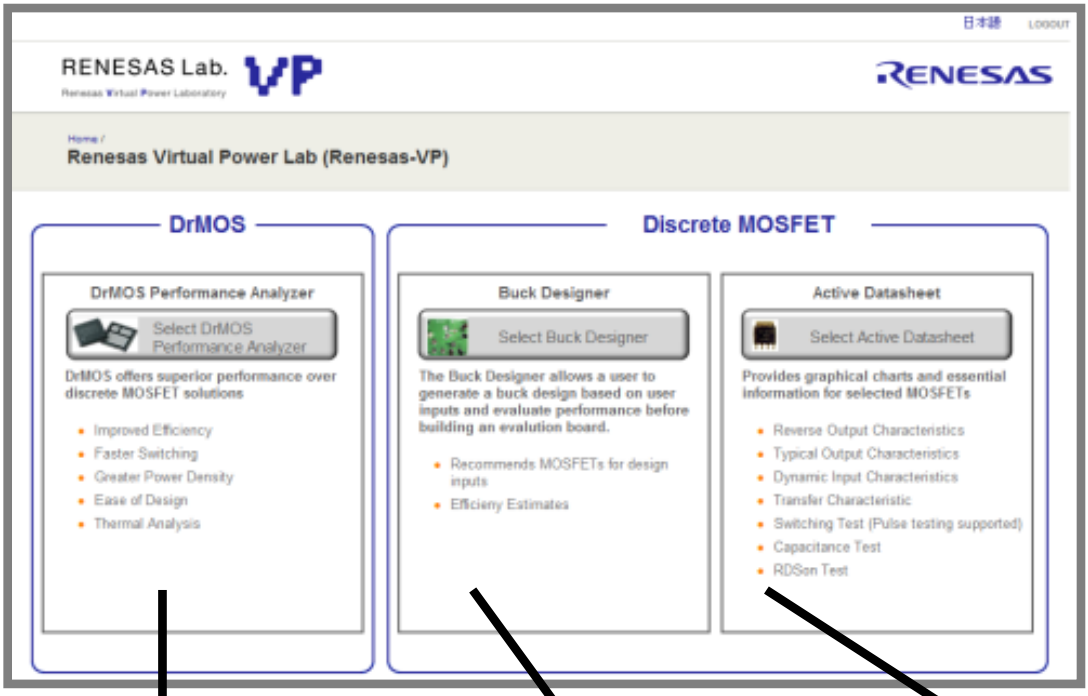
: Enable to grasp the further characteristics with adjusting each parameter compared to a static datasheet.

BUCK DESIGNER

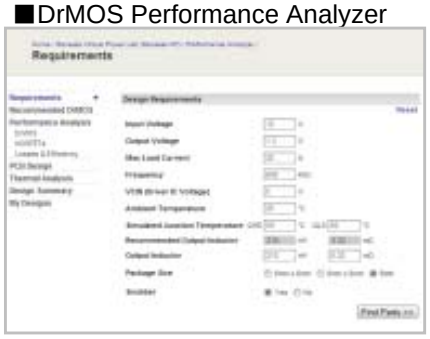
: Enable to simulate the operation of power MOSFET of synchronous rectification method buck converters.

DrMOS PERFORMANCE ANALYZER

: Enable to simulate the operation of DrMOS which offers superior performance over discrete solution.

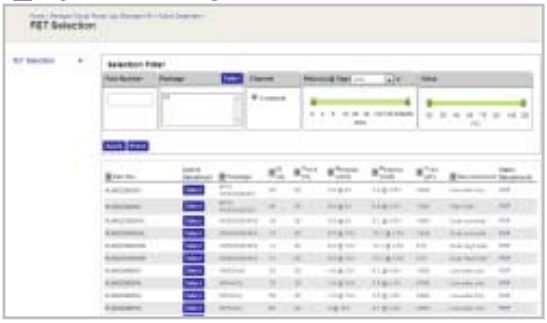


■DrMOS Performance Analyzer



■BUCK DESIGNER

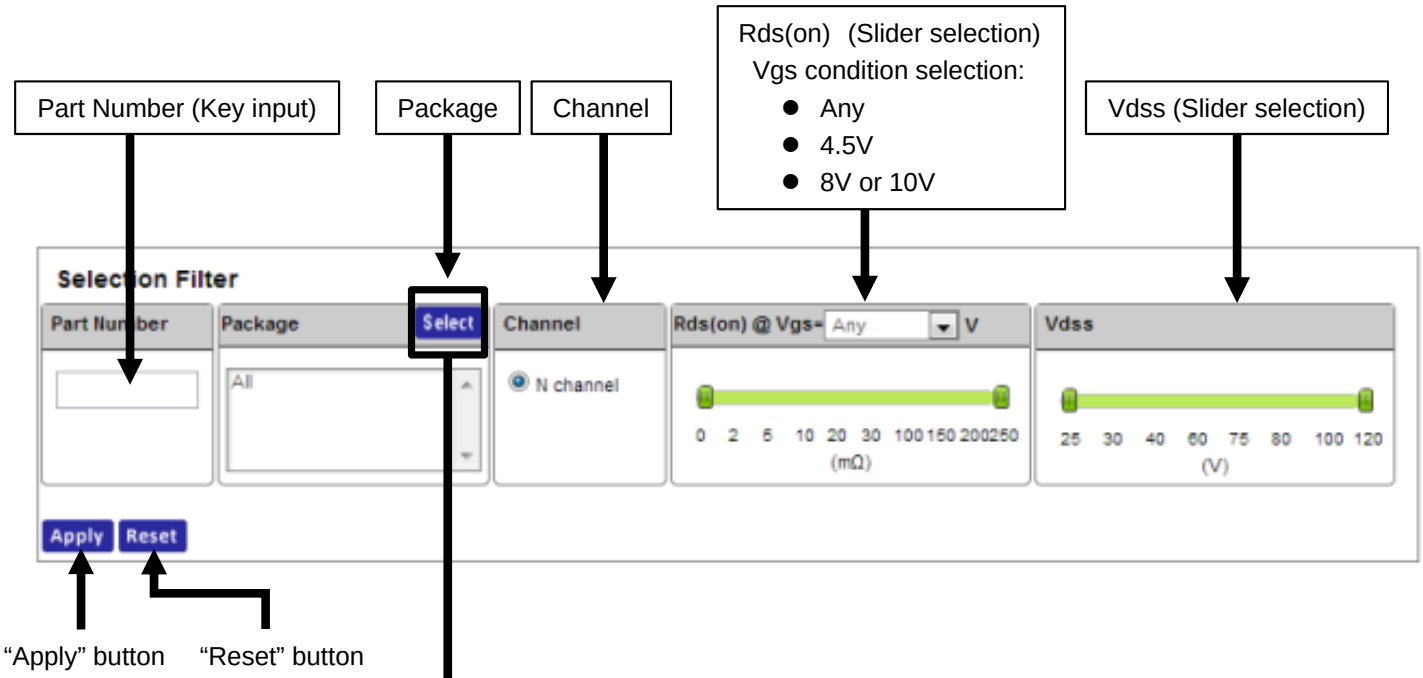
■ACTIVE DATASHEET

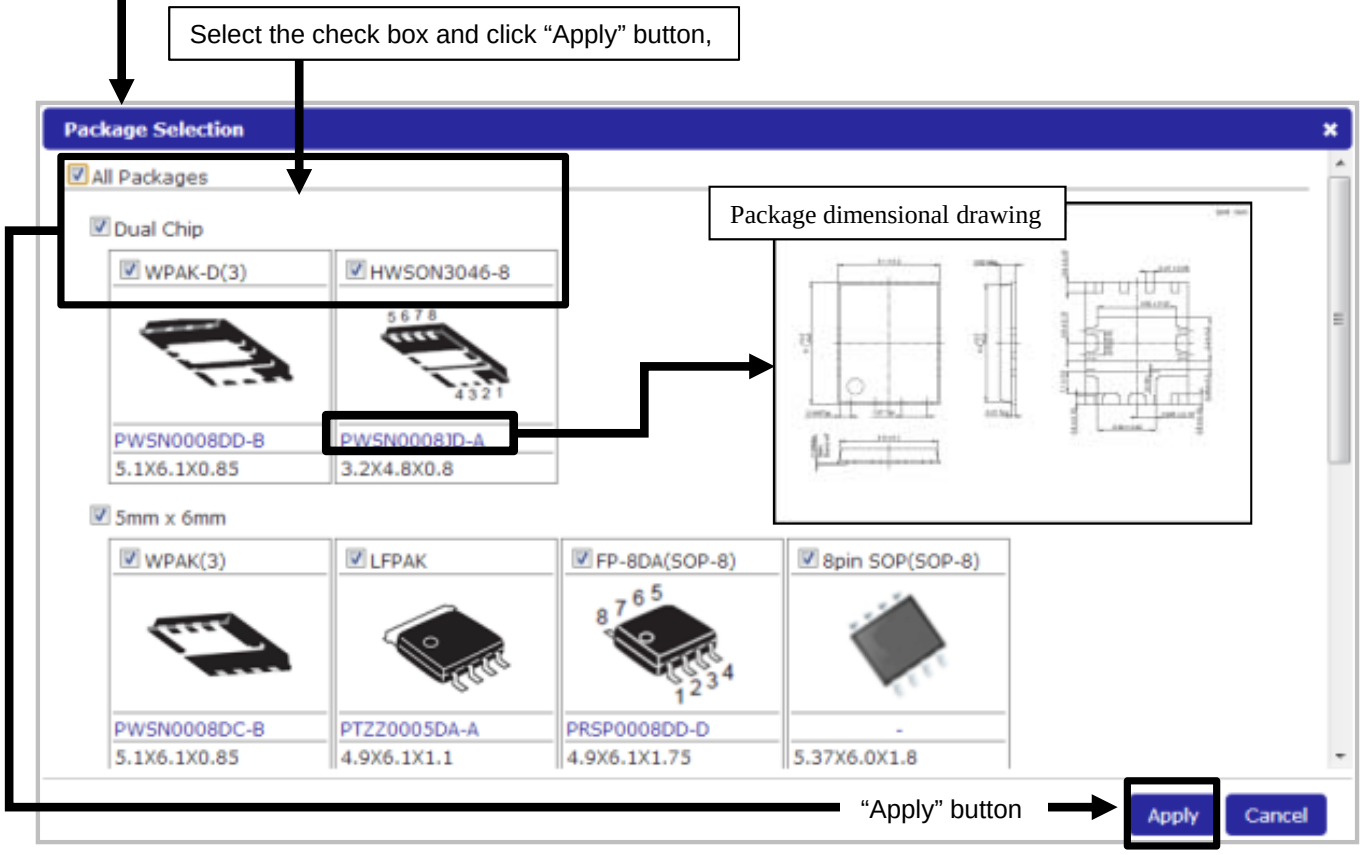


4. Active Datasheet

4-1. Product Search

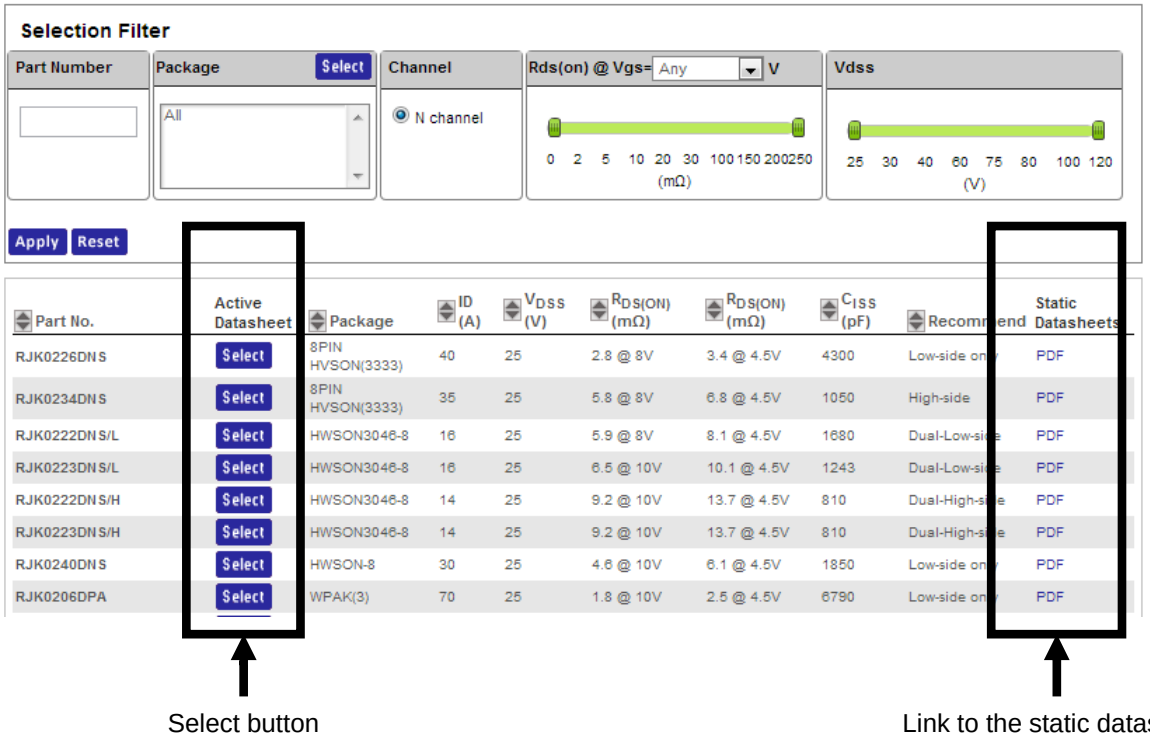
The product selection filter and product lineup of power MOSFET is appeared. At first, input search conditions: Part Number, Package, Channel, Rds(on), and Vdss. After that, clicking “Apply” button, the product lineup is narrowed down by your conditions.





4-2. Product Selection

Select the product you would like to simulate on this page by reference to parameters or static datasheets.

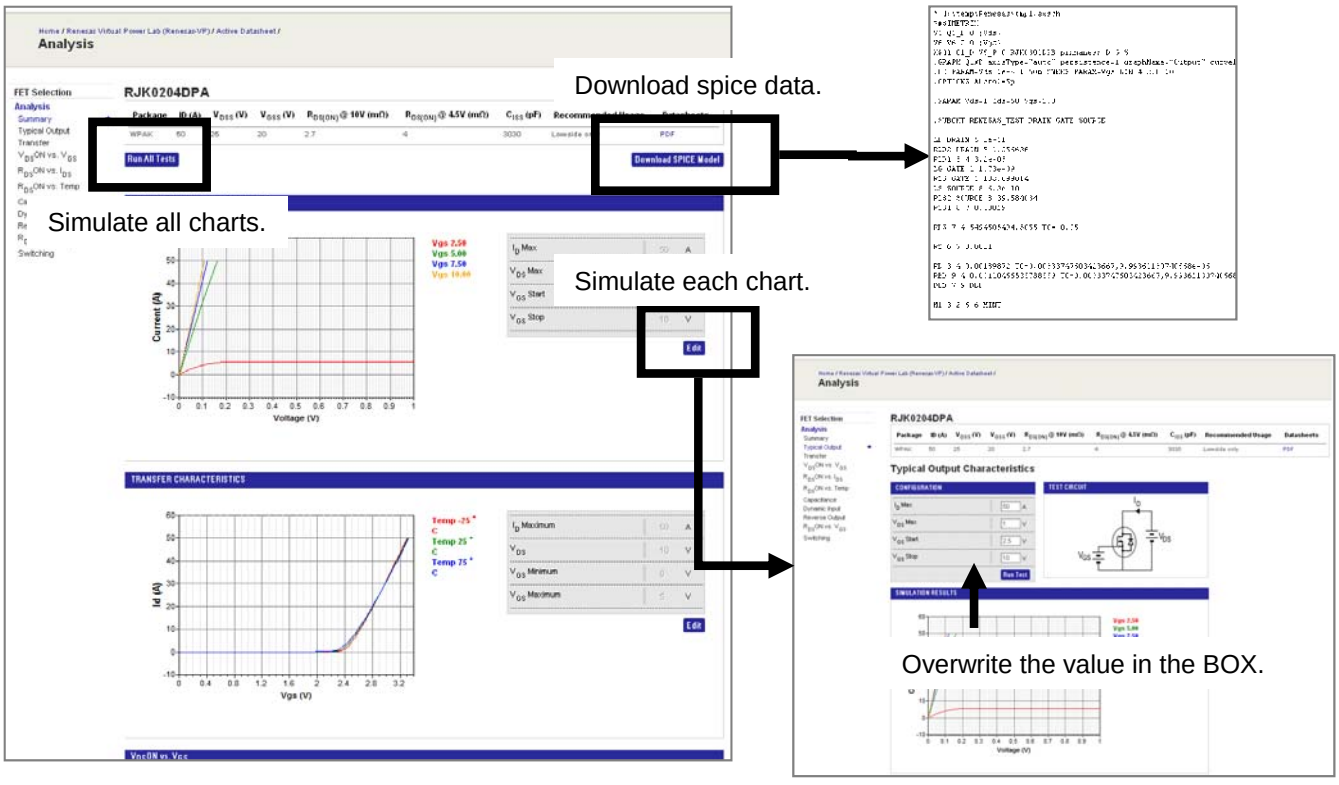

Selection Filter
Part Number
Package
Select
All
Channel
N channel
Rds(on) @ Vgs= Any V
0 2 5 10 20 30 100 150 200250
(mΩ)
Vdss
25 30 40 60 75 80 100 120
(V)
Apply
Reset
Part No.
Active Datasheet
Package
ID (A)
VDSS (V)
RDS(ON) (mΩ)
RDS(ON) (mΩ)
CISS (pF)
Recommend
Static Datasheets
RJK0226DNS Select 8PIN HVSON(3333) 40 25 2.8 @ 8V 3.4 @ 4.5V 4300 Low-side only PDF
RJK0234DNS Select 8PIN HVSON(3333) 35 25 5.8 @ 8V 6.8 @ 4.5V 1050 High-side PDF
RJK0222DNS/L Select HWSON3046-8 16 25 5.9 @ 8V 8.1 @ 4.5V 1680 Dual-Low-side PDF
RJK0223DNS/L Select HWSON3046-8 16 25 6.5 @ 10V 10.1 @ 4.5V 1243 Dual-Low-side PDF
RJK0222DNS/H Select HWSON3046-8 14 25 9.2 @ 10V 13.7 @ 4.5V 810 Dual-High-side PDF
RJK0223DNS/H Select HWSON3046-8 14 25 9.2 @ 10V 13.7 @ 4.5V 810 Dual-High-side PDF
RJK0240DNS Select HWSON-8 30 25 4.6 @ 10V 6.1 @ 4.5V 1850 Low-side only PDF
RJK0206DPA Select WPAK(3) 70 25 1.8 @ 10V 2.5 @ 4.5V 6790 Low-side only PDF
Select button
Link to the static datasheet

4-3. Simulation of Each Chart

The analysis page of default values is appeared.

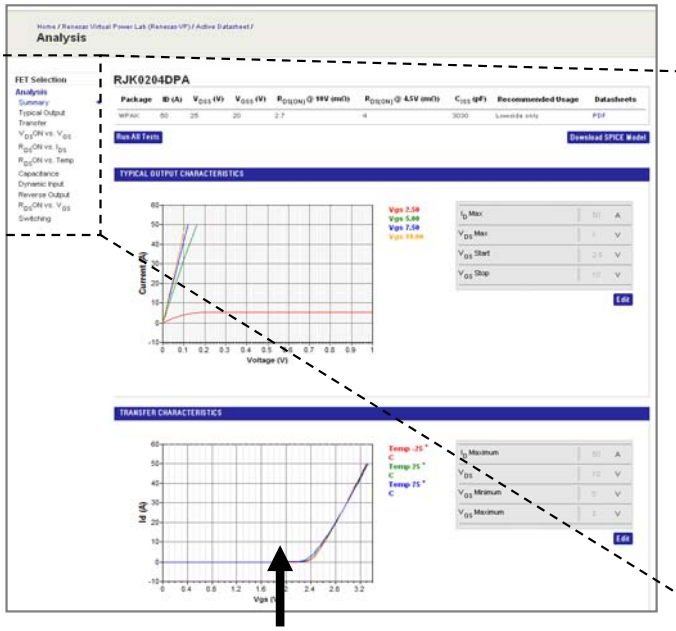
If you want to continue the simulation by default values, the simulation of all charts starts by clicking “RUN ALL TEST”.

If you would like to change the values, please change it by overwriting on the setting page which is appeared by clicking “EDIT” button under each setting table. And start a simulation by clicking “RUN TEST” after that.



4-4. Characteristics Map

Thumbnails of each chart are appeared after you click “RUN ALL TEST”. The detailed characteristics map is opened in a viewer by clicking these thumbnails.



The page of blue-colored text is displayed.

FET Selection

Analysis

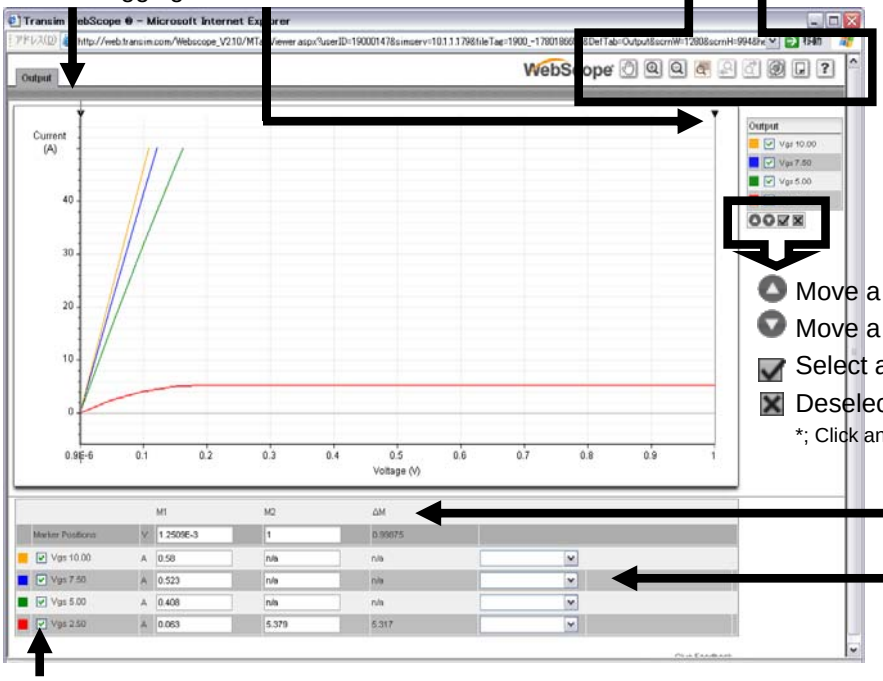
Summary	: Display all charts
Typical Output	: Output characteristic (typ.)
Transfer	: Transfer characteristic
$V_{DS}ON$ vs. V_{GS}	: VGS characteristic of VDSON
$R_{DS}ON$ vs. I_{DS}	: Drain current characteristic of RDSON
$R_{DS}ON$ vs. Temp	: Temp. characteristic of RDSON
Capacitance	: VDS characteristic of capacitance (Coss, Ciss, Crss)
Dynamic Input	: Capacitance change by VGS
Reverse Output	: Reverse current characteristic by VSD
$R_{DS}ON$ vs. V_{GS}	: RDSON characteristic by VGS
Switching	: Switching characteristic

Click a thumbnail, and open a viewer.

4-5. Operation of Viewer

[Drag]	: Move the waveform according to the mouse movement in zoomed mode..
[Zoom In]	: Enlarges the waveform displayed stepwise by x%.
[Zoom Out]	: Shrinks the waveform displayed stepwise by x%.
[Marquee Zoom]	: Enlarges the waveform in the selected area to the full size of the screen (area zoom).
[Go back one zoom level]	: Go back one zoomed level.
[Go forward one zoom level]	: Go forward one zoomed level.
[Reset Zoom]	: Reset the zoomed mode to its default.
[Print Waveforms]	: Print the waveforms.

Move the position of [M1] and [M2] with dragging vertical lines.



Move a selected waveform up. (*)
Move a selected waveform down. (*)
Select all waveforms.
Deselect all waveforms.
*; Click an item name to select.

Display the values of [M1] and [M2].

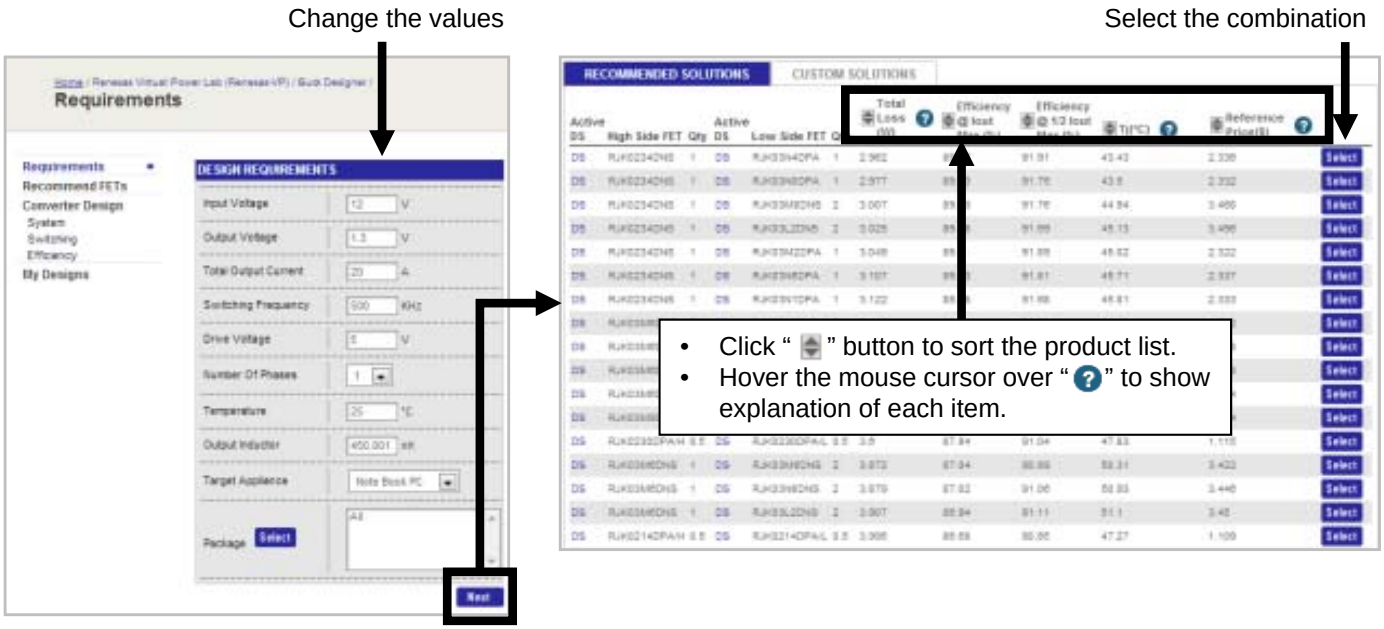
Use functions such as RSM, average and peak values.

Checking or un-checking the checkbox in front of the waveform name will turn the display on or off.

5. Buck Designer (Recommended FETs)

5-1. Condition Setting and Combination Selection

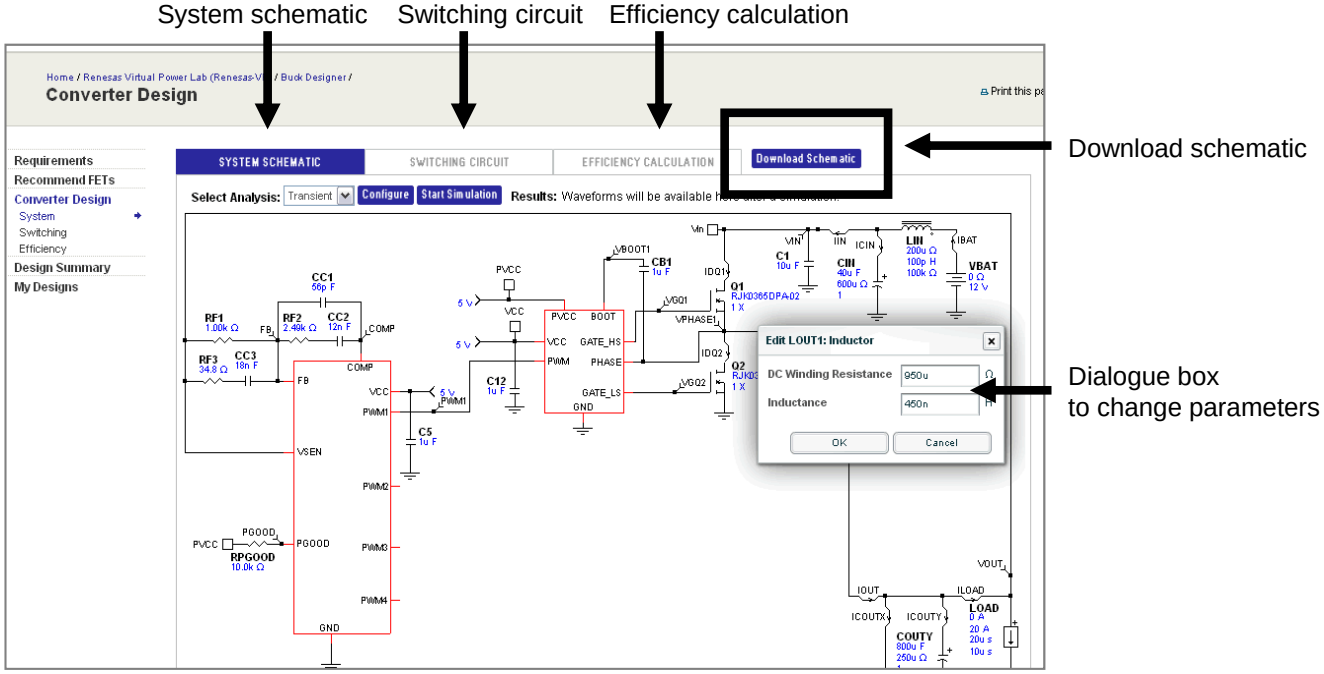
The “Requirements” screen to set conditions is appeared. Set the values of DC/DC converter such as input voltage, output voltage and phases at first. After that, recommended combinations of power MOSFETs which are selected based on your requirements are displayed by clicking “Next” button. Then select the combination you would like to check by clicking “Select” button.



5-2. System Schematic and Switching Circuit

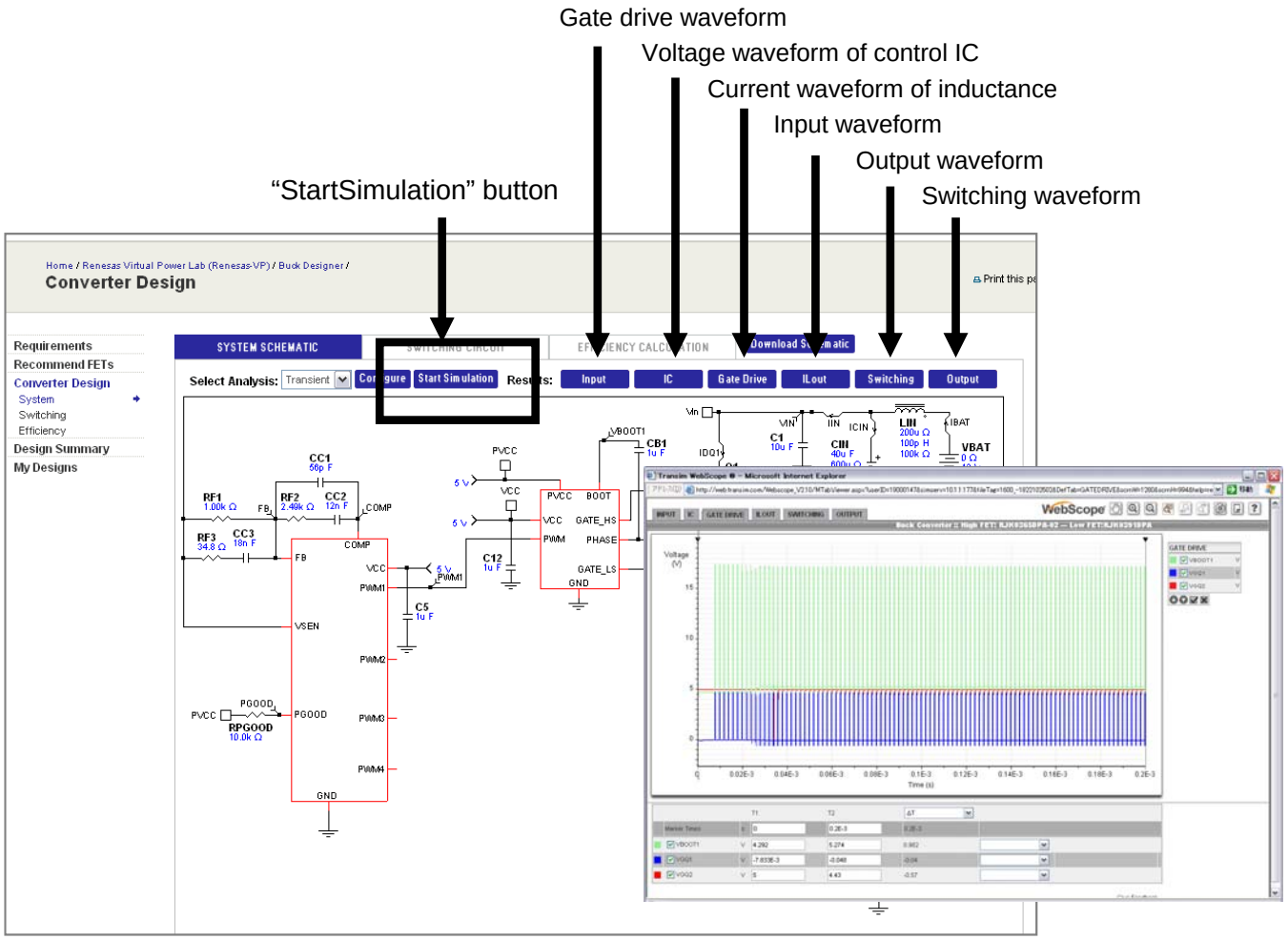
The system schematic is appeared by selecting one of recommended combinations at first. It allows to edit values in the dialogue box by clicking blue-colored one.

Note; System circuit and switching circuit are prepared in this converter design page, and blue-colored parameters of both circuits are editable. However, please check the switching circuit to get accurate characteristics because system circuit is omitted some parameters such as floating impedances to keep the calculation scale within its reasonable values.



5-3. Waveform Chart of Each Point

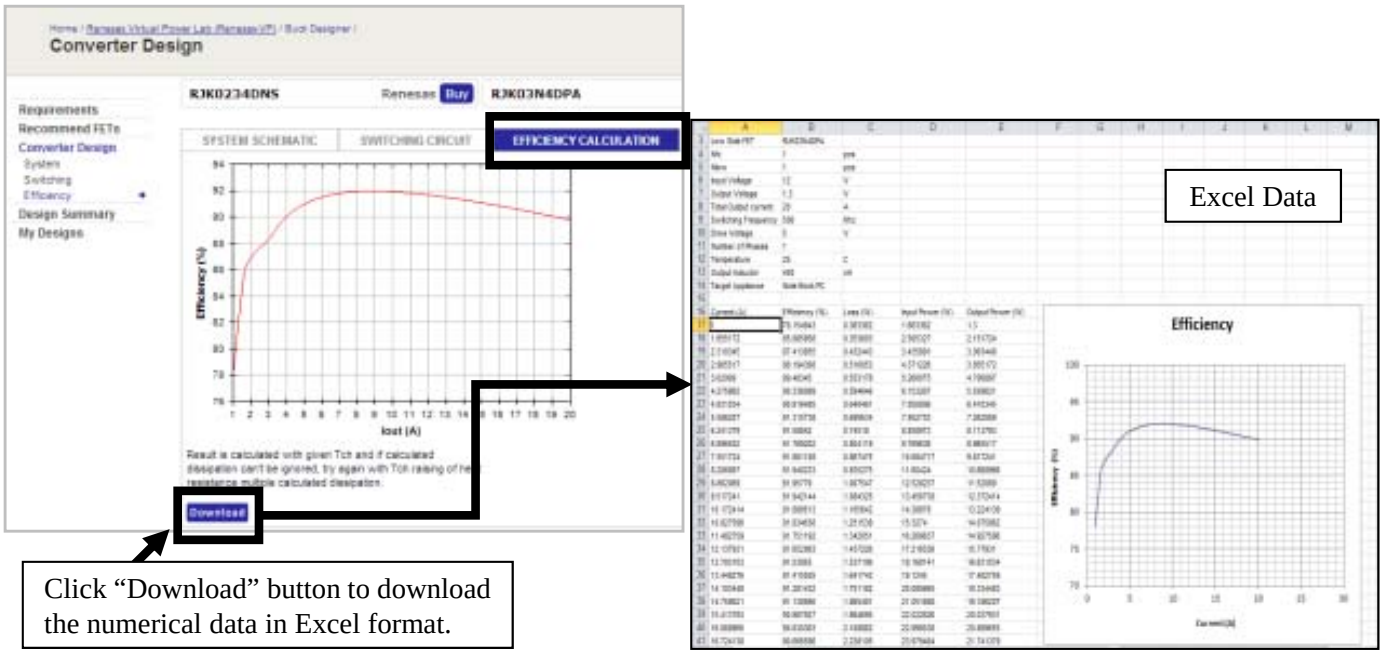
Buttons to show each waveform are appeared in a result space by clicking “Start Simulations” button. Every waveform allows to scale, move and read the value in an original viewer.



5-4. Efficiency Curve

The efficiency curve of switching circuit is appeared by clicking the tab of “EFFICIENCY CALUCULATION”.

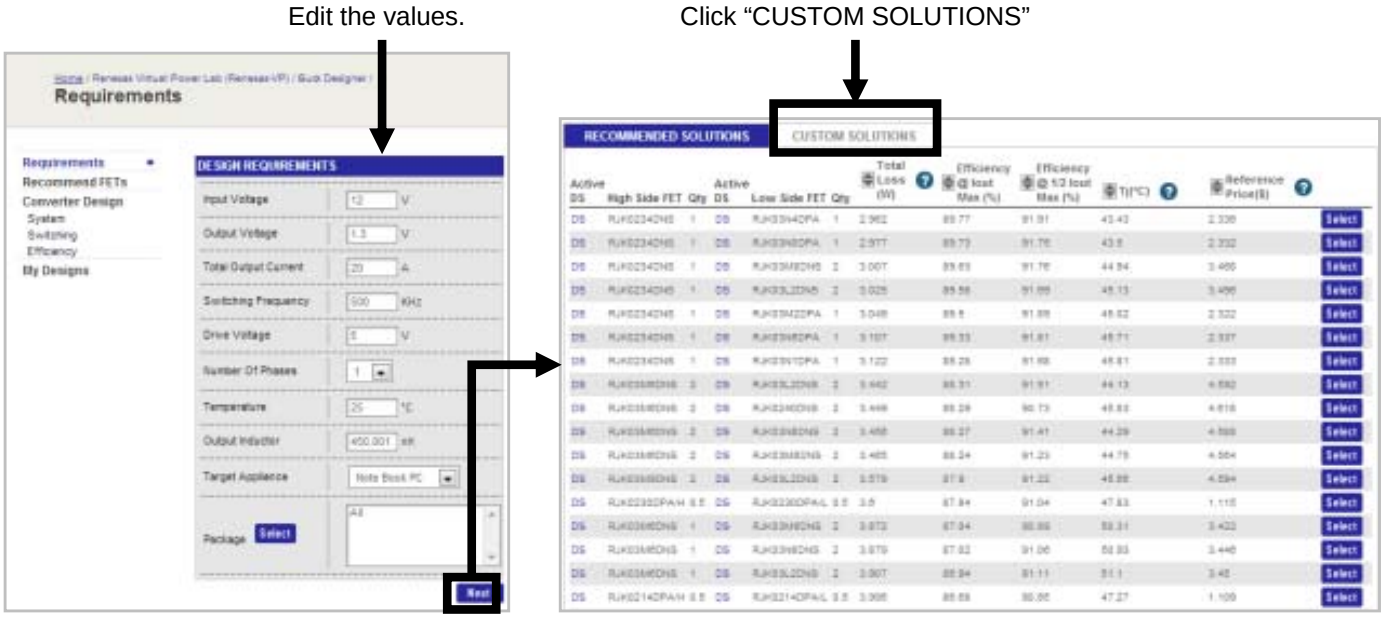
This simulation is calculated at the value on set Tch. Therefore when you can not ignore a rise in temperature by the loss, you need to simulate again with adding a resultant rise by multiplying the thermal resistance to a resultant loss of power MOSFET to the initial set values.



6. Buck Designer (Custom Solutions)

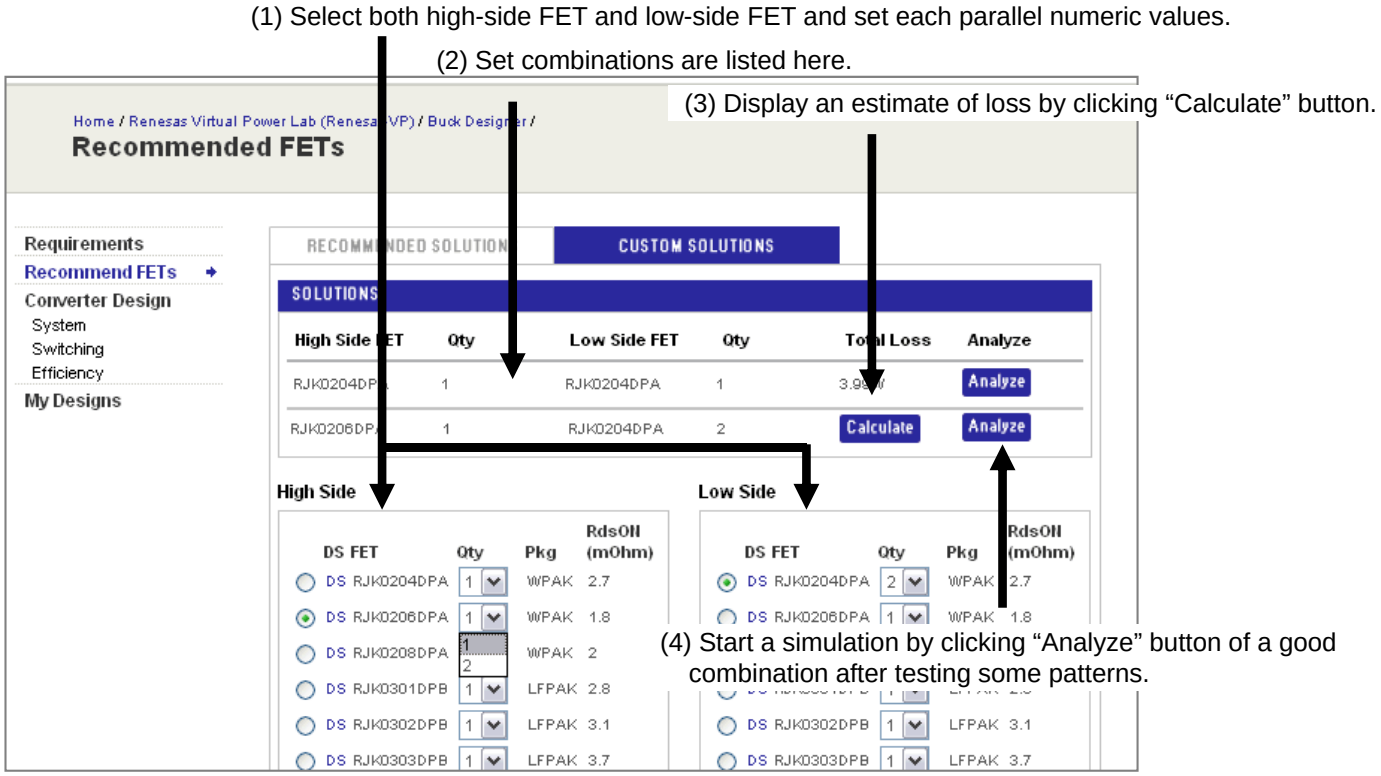
6-1. Condition Setting

The “Requirements” screen to set conditions is appeared. Set the values of DC/DC converter such as input voltage, output voltage and phases at first. After that, recommended combinations are displayed by clicking “Next” button. However if you want to try custom solutions, click the tub of “CUSTOM SOLUTIONS” at this time.



6-2. Custom Combination Setting

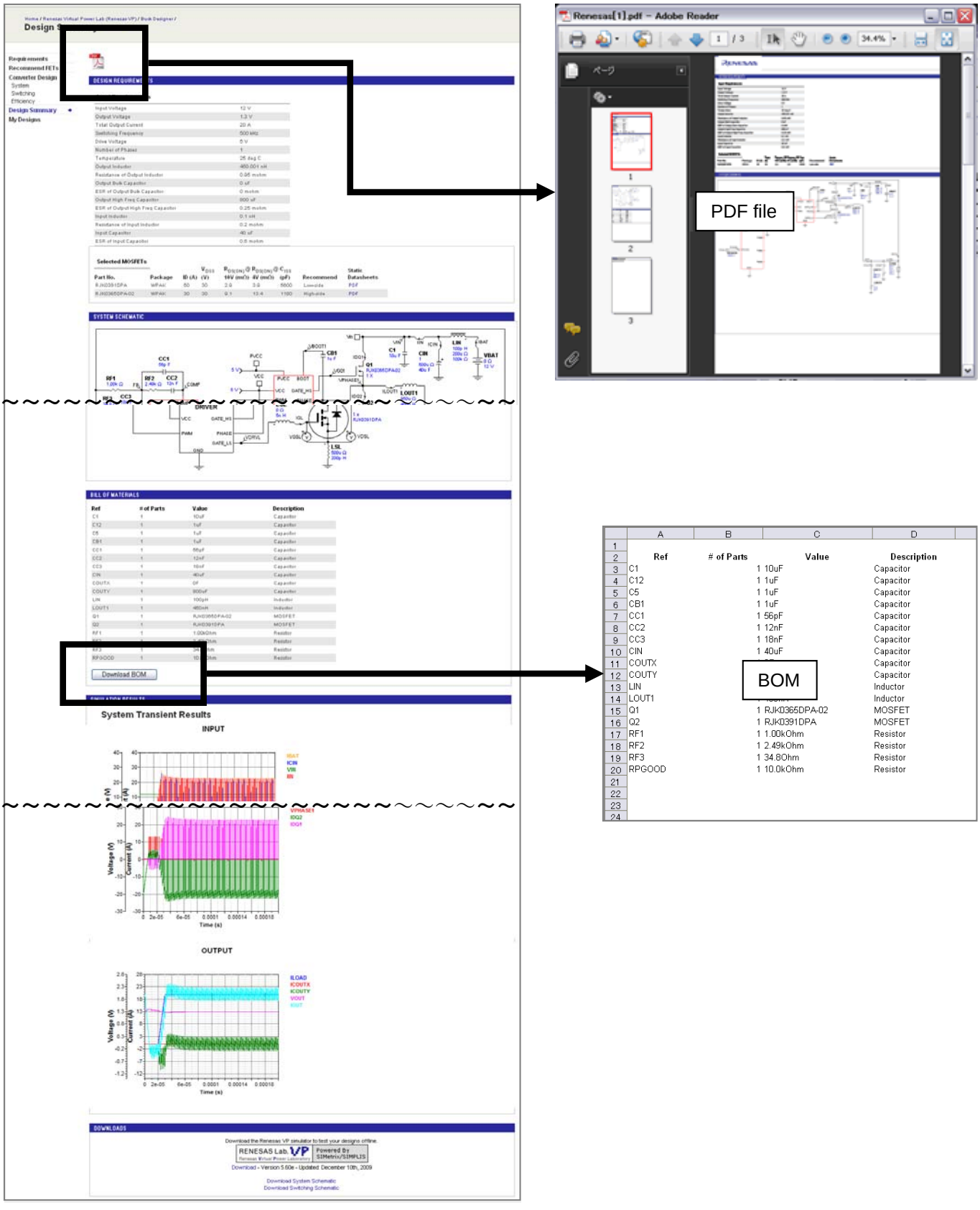
Set a combination you would like to simulate as below, and start a simulation as in case of recommend combinations.



7. Buck Designer (Other Functions)

7-1. Design Summary

View the summary of a simulation by Buck Designer. Furthermore, you can download the page by PDF format and BOM by Excel format.



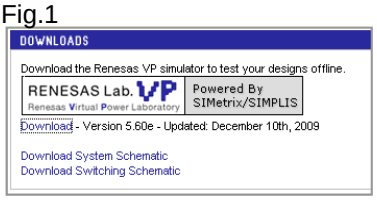
	A	B	C	D
1				
2	Ref	# of Parts	Value	Description
3	C1	1	10uF	Capacitor
4	C12	1	1uF	Capacitor
5	C5	1	1uF	Capacitor
6	CB1	1	1uF	Capacitor
7	CC1	1	56pF	Capacitor
8	CC2	1	12nF	Capacitor
9	CC3	1	18nF	Capacitor
10	CIN	1	40uF	Capacitor
11	COUTX			Capacitor
12	COUTY			Capacitor
13	LIN			Inductor
14	LOUT1			Inductor
15	Q1	1	RJK0365DPA-02	MOSFET
16	Q2	1	RJK0391DPA	MOSFET
17	RF1	1	1.00kOhm	Resistor
18	RF2	1	2.49kOhm	Resistor
19	RF3	1	34.8Ohm	Resistor
20	RPGOOD	1	10.0kOhm	Resistor
21				
22				
23				
24				

7-2. Downloadable Simulation Tool

The simulation tool for off-line is available after a simulation.

(1) Download a simulation tool, the data of a system schematic and a switching schematic from the bottom of Design Summary page (Fig.1), and save them to your own PC. Please note that the file may be a large size.

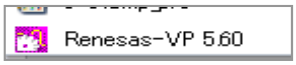
Fig.1


DOWNLOADS
Download the Renesas VP simulator to test your designs offline.
RENESAS Lab. VP
Renesas Virtual Power Laboratory
Powered By SIMetrix/SIMPLIS
Download - Version 5.60e - Updated: December 10th, 2009
Download System Schematic
Download Switching Schematic

(2) Double-click on the simulation tool (Fig2. RenesasVP.exe) to install. The menu of "Renesas-VP" is added to a start menu of your PC (Fig.3) when the installs are done.

Fig.2

Fig.3

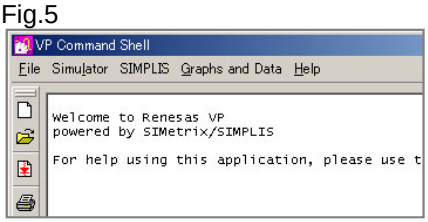


(3) Click the menu, and click "OK" on the screen (Fig.4) to start.

Fig.4

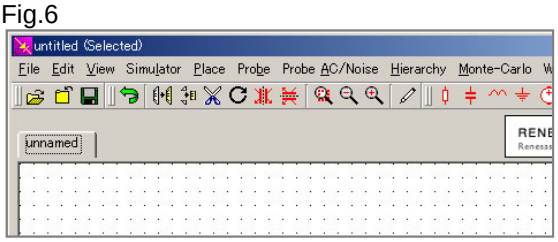
(4) Start a simulation by selecting downloaded data such as a circuit data and a spice data online on the next screen (Fig.5).

Fig.5


VP Command Shell
File Simulator SIMPLIS Graphs and Data Help
Welcome to Renesas VP
powered by SIMetrix/SIMPLIS
For help using this application, please use t

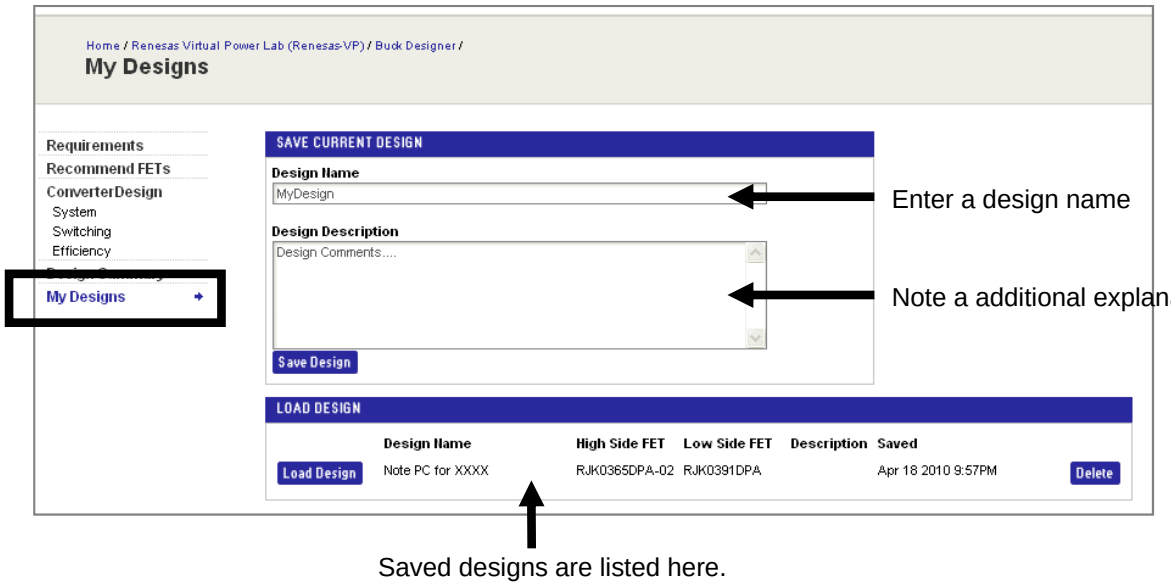
(5) Although there are some limitations in function, this tool allows to simulation on the screen (Fig.6) by making other circuit data.
Note; This tool fulfills its original function when a downloaded circuit schematic on this site is combined with Renesas power MOSFETs.

Fig.6



7-3. My Designs

Save or load to use again the personal designed data by Buck Designer.



Enter a design name

Note a additional explanations or comments

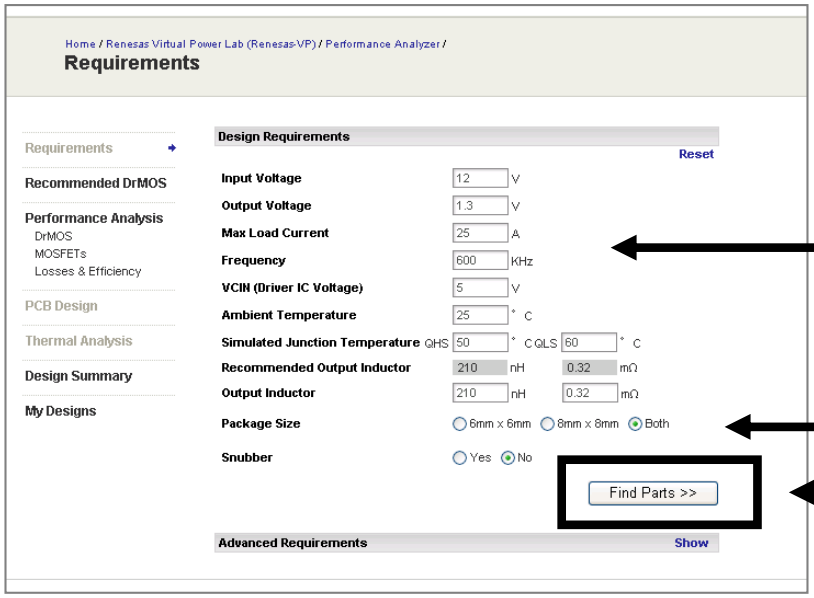
Saved designs are listed here.

8. DrMOS Performance Analyzer

Enable to simulate the operation of DrMOS which offers superior performance over discrete solution. Beside SPICE simulation, you can also simulate thermal analysis.

8-1. Condition Setteing

On landing page, select “DrMOS Performance Analyzer”, at first the condition setting page (Requirements) is displayed. Please input operation conditions.



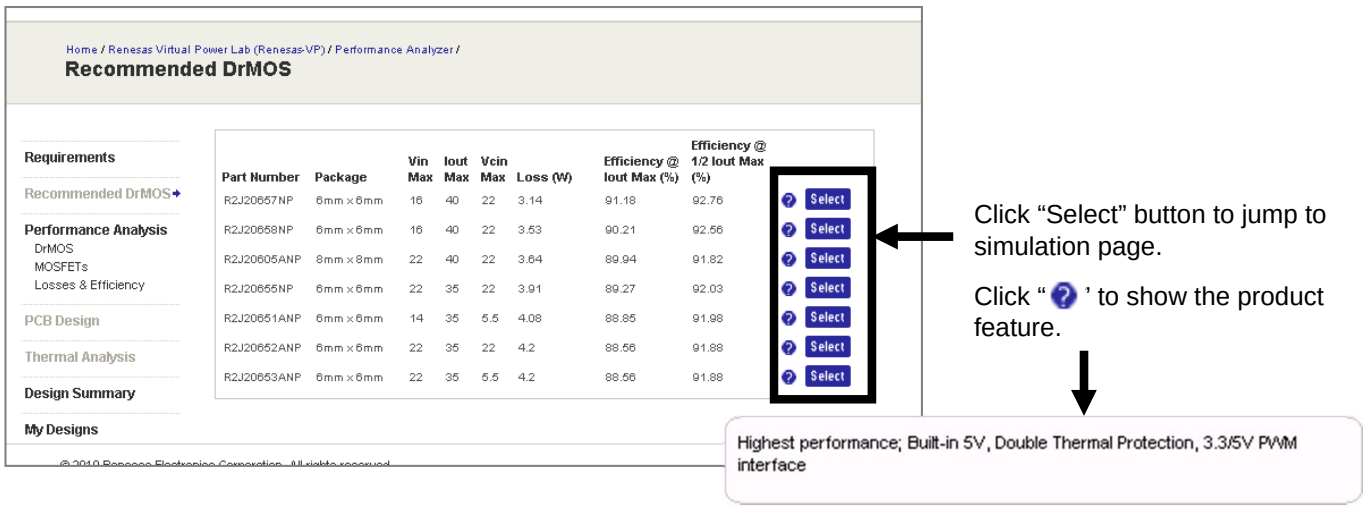
Input power supply conditions.

Decide package size of DrMOS.

Click “Find Parts >>” button to jump to the recommended DrMOS list.

8-2. Product Selection

Display the recommended DrMOS product list. Please select part number for simulation.

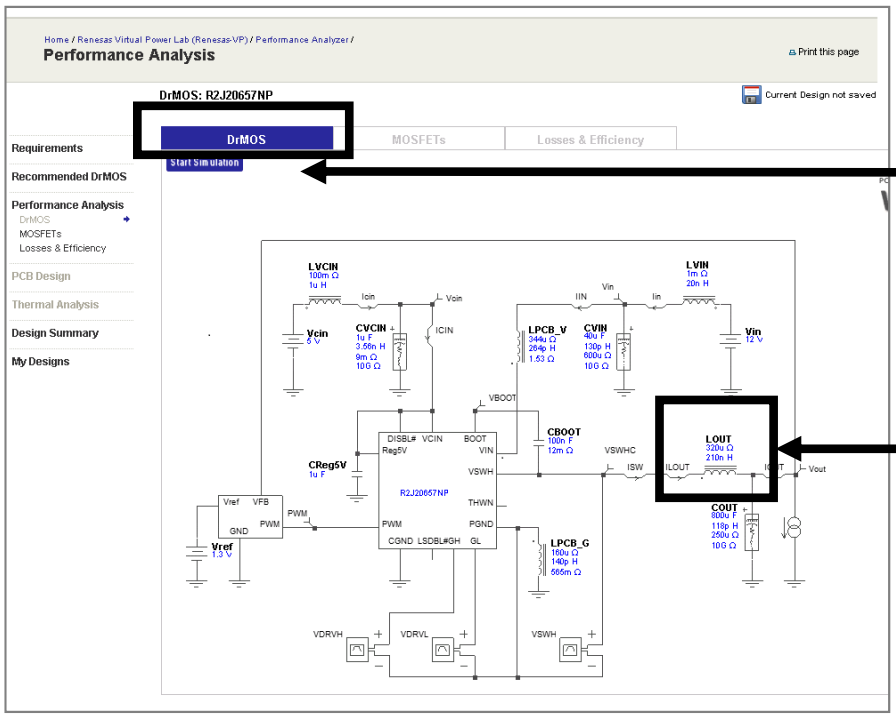

Home / Renesas Virtual Power Lab (Renesas-VP) / Performance Analyzer /
Recommended DrMOS
Requirements
Recommended DrMOS
Performance Analysis
DrMOS
MOSFETs
Losses & Efficiency
PCB Design
Thermal Analysis
Design Summary
My Designs
Part Number Package Vin Max Iout Max Vcin Max Loss (W) Efficiency @ Iout Max (%) Efficiency @ 1/2 Iout Max (%)
R2J20657NP 6mm x 6mm 16 40 22 3.14 91.18 92.76 Select
R2J20658NP 6mm x 6mm 16 40 22 3.53 90.21 92.56 Select
R2J20605ANP 8mm x 8mm 22 40 22 3.64 89.94 91.82 Select
R2J20655NP 6mm x 6mm 22 35 22 3.91 89.27 92.03 Select
R2J20651ANP 6mm x 6mm 14 35 5.5 4.08 88.85 91.98 Select
R2J20652ANP 6mm x 6mm 22 35 22 4.2 88.56 91.88 Select
R2J20653ANP 6mm x 6mm 22 35 5.5 4.2 88.56 91.88 Select
Highest performance; Built-in 5V, Double Thermal Protection, 3.3/5V PWM interface

Click “Select” button to jump to simulation page.

Click “ ? ’ to show the product feature.

8-3. DrMOS Solution Circuit

The selected DrMOS circuit diagram is displayed.

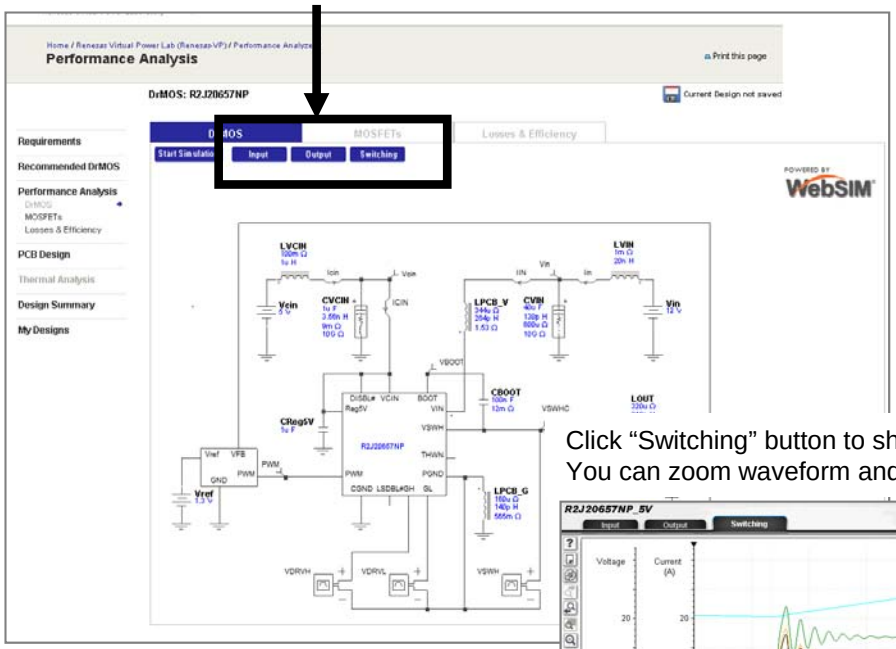


Click “Start Simulation” button to start the operation waveform simulation.

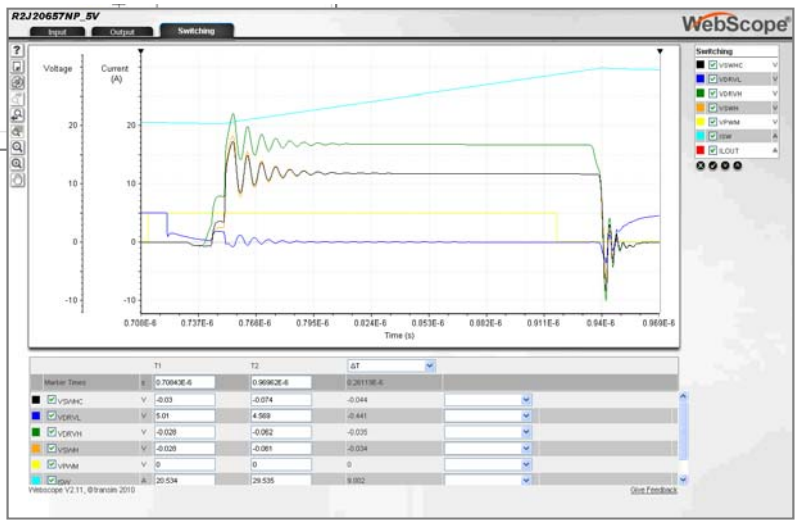
Click peripheral parts to change parameters (blue text).

8-4. DrMOS Solution Circuit (after Simulation)

After simulation, “Input”, “Output”, and “Switching” button are displayed. Click each button to show the operation waveform.

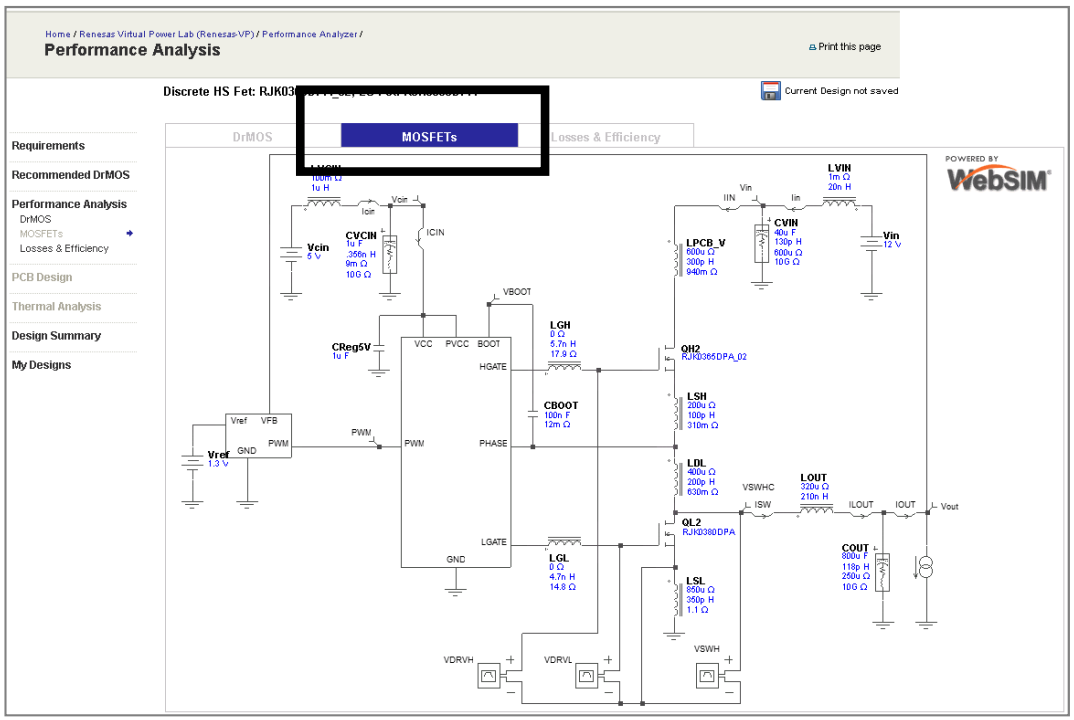


Click “Switching” button to show the diagram below.
You can zoom waveform and read numerical data by marker.



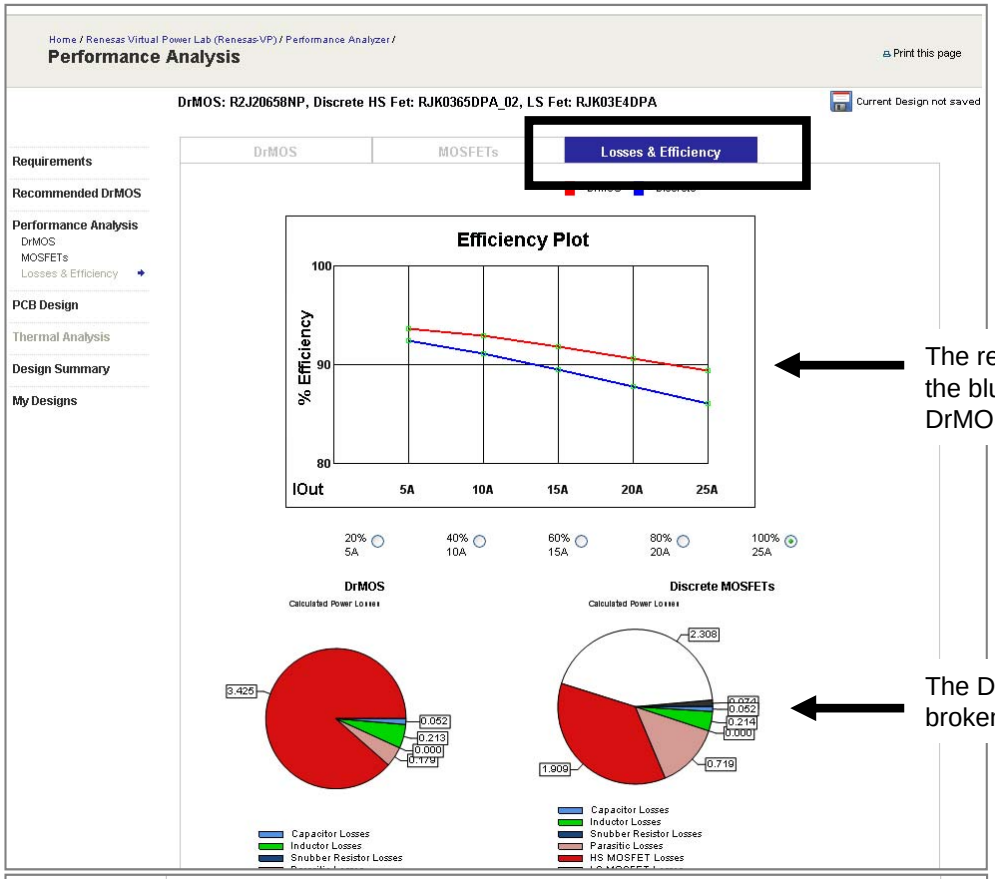
8-5. Discrete MOSFETs Solution Circuit

You can also simulate the discrete MOSFETs solution. This MOSFET combination are equal in Rds(on) to the DrMOS.



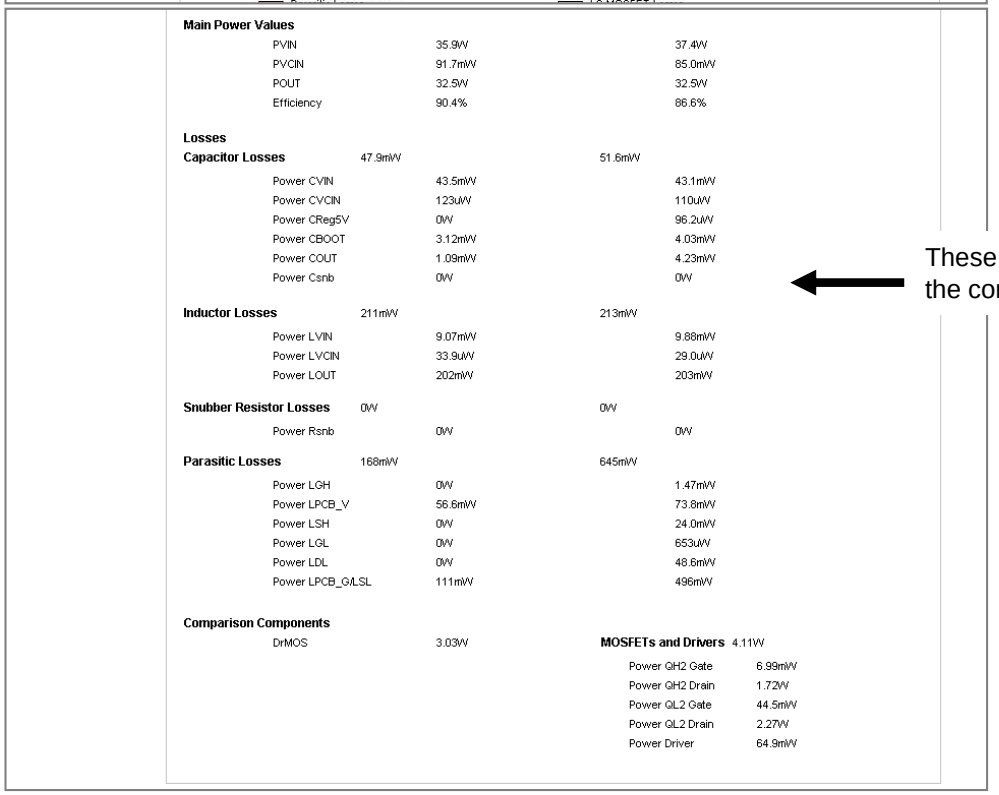
8-6. Losses & Efficiency

You can compare the losses and efficiency of DrMOS solution with discrete solution.



The red line represents DrMOS and the blue line represents discrete. DrMOS has advantage over discrete.

The DrMOS and discrete losses are broken down into components.



Main Power Values

PVIN	35.9W	37.4W
PVCIN	91.7mW	85.0mW
POUT	32.5W	32.5W
Efficiency	90.4%	86.6%

Losses

Capacitor Losses	47.9mW	51.6mW
Power CVIN	43.5mW	43.1mW
Power CVCIN	123uW	110uW
Power CReg5V	0W	96.2uW
Power CBOOT	3.12mW	4.03mW
Power COUT	1.09mW	4.23mW
Power Csnb	0W	0W
Inductor Losses	211mW	213mW
Power LVIN	9.07mW	9.88mW
Power LVCIN	33.9uW	29.0uW
Power LOUT	202mW	203mW
Snubber Resistor Losses	0W	0W
Power Rsnb	0W	0W
Parasitic Losses	168mW	645mW
Power LGH	0W	1.47mW
Power LPCB_V	56.6mW	73.8mW
Power LSH	0W	24.0mW
Power LGL	0W	653uW
Power LDL	0W	48.6mW
Power LPCB_G/LSL	111mW	496mW

Comparison Components

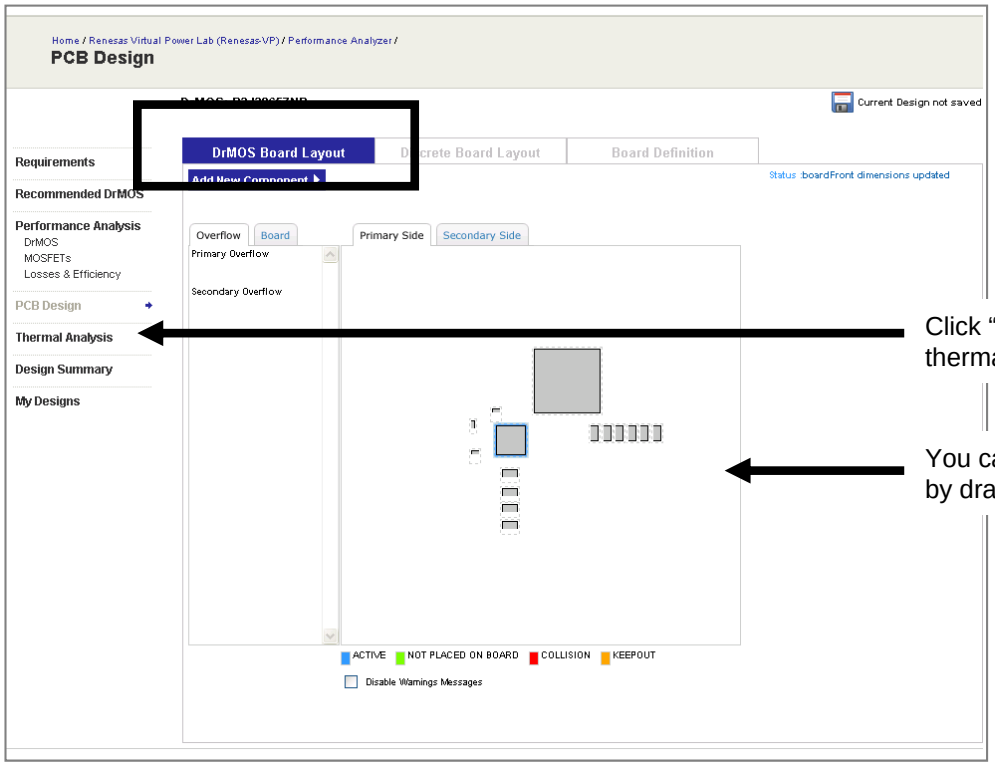
DrMOS	3.03W	**MOSFETs and Drivers**	4.11W
		Power QH2 Gate	6.99mW
		Power QH2 Drain	1.72W
		Power QL2 Gate	44.5mW
		Power QL2 Drain	2.27W
		Power Driver	64.9mW

These numerical data are the components of losses.

8-7. PCB Design for DrMOS Board Layout

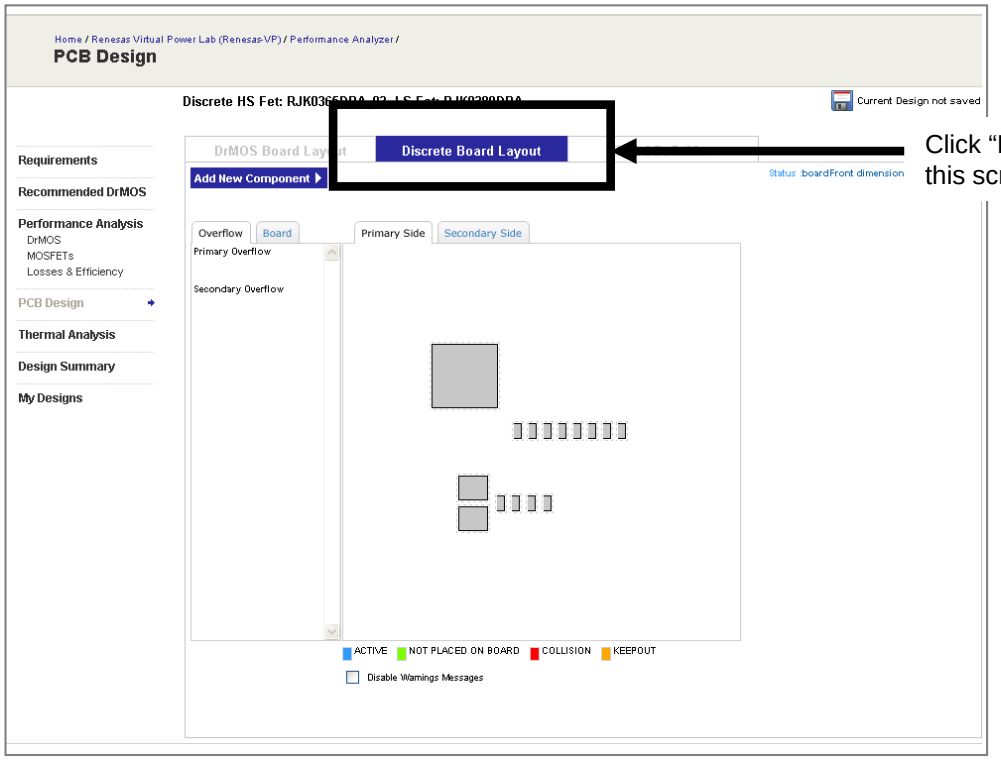
In 8-7. to 8-11. sections, the operation of thermal analysis is explained.

This section is about DrMOS board layout design. The heat values of each parts are calculated in aforementioned circuit simulation, and these valued are automatically inputted.



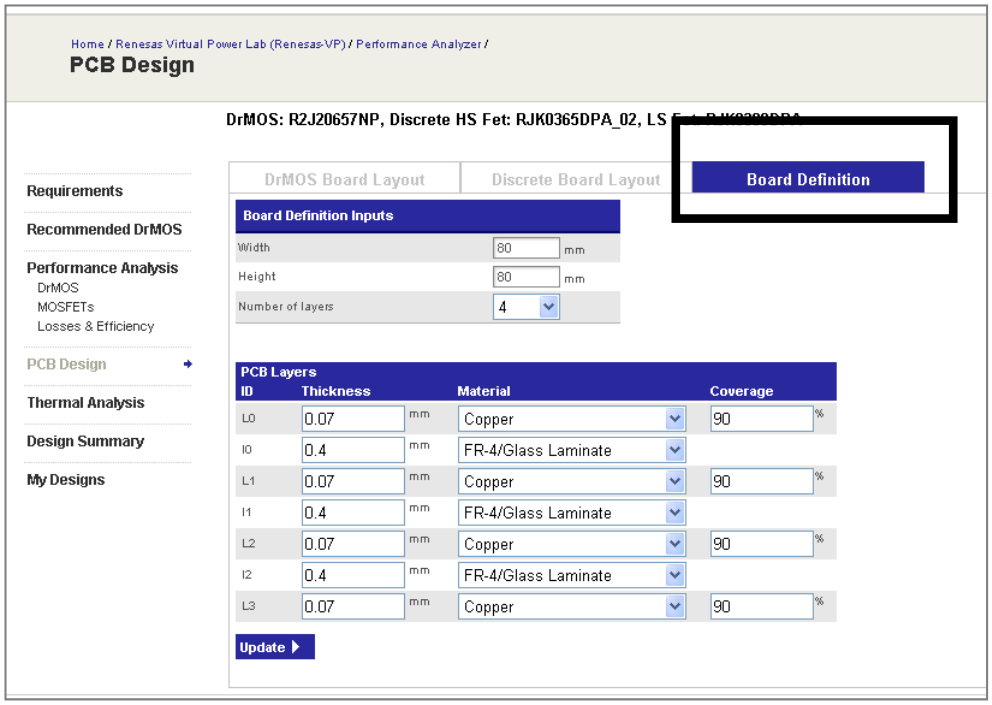
8-8. PCB Design for Discrete Solution Board Layout

Below is a operation screen of discrete solution board layout.



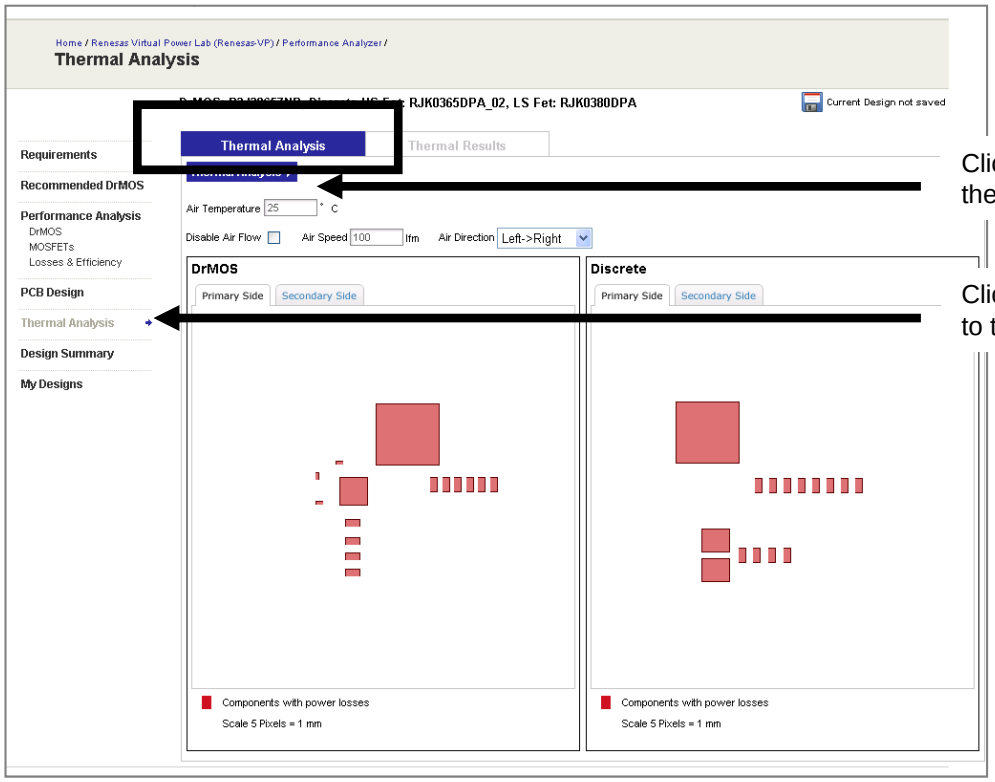
8-9. PCB Design for Board Specification

Below is a operation screen for setting board size, thickness and number of layers.



8-10. Airflow Setting

below is a operation screen for airflow setting.

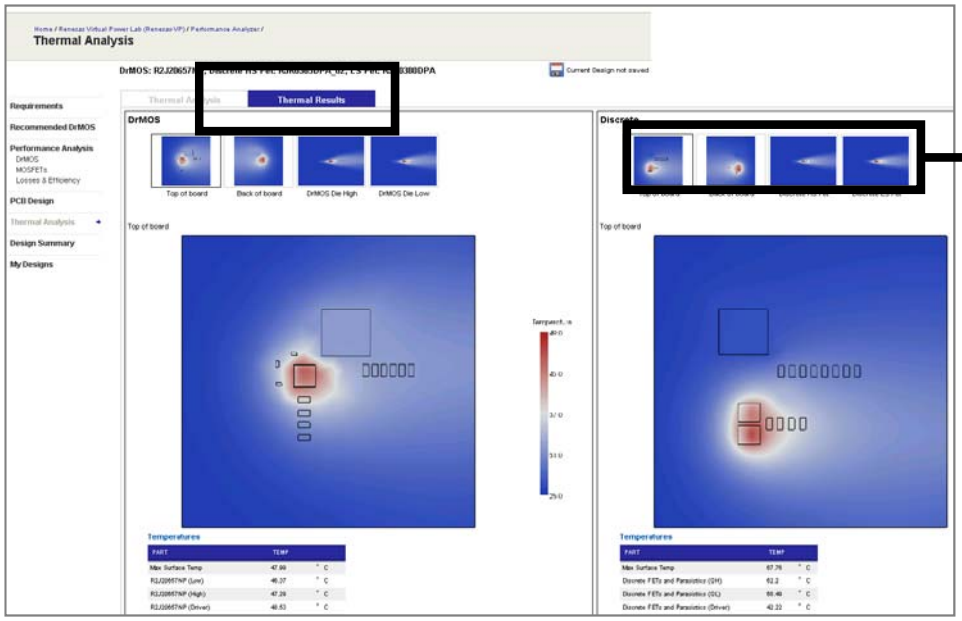


Click “Start Simulation” to start thermal analysis.

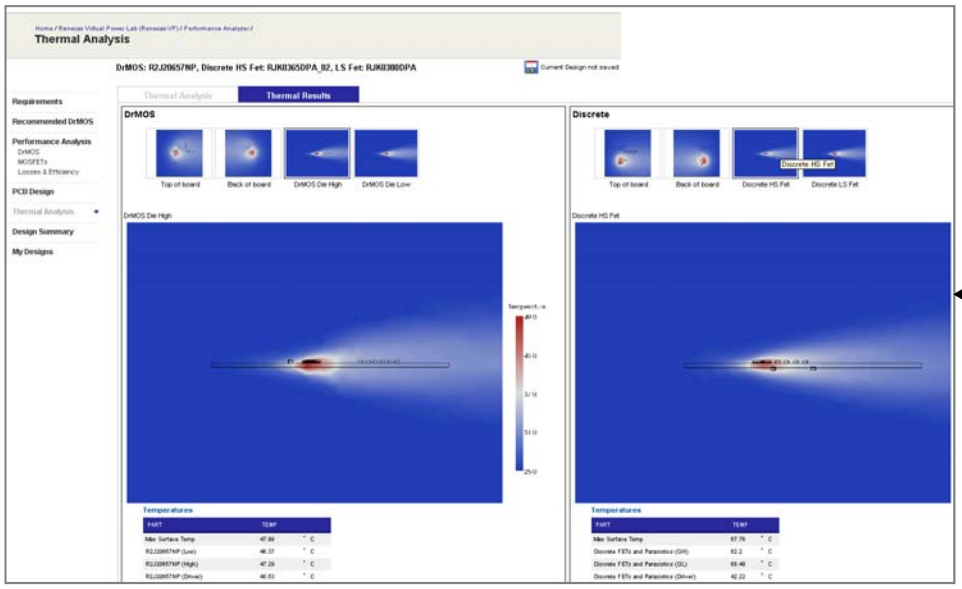
Click “Thermal Analysis” to jump to this screen.

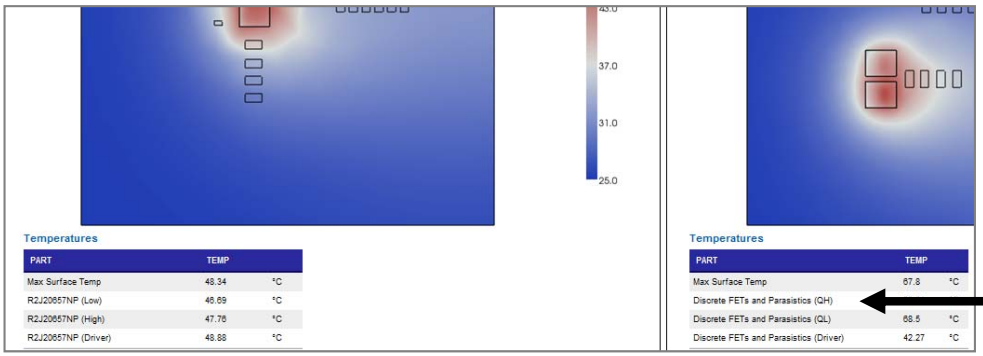
8-11. Thermal Analysis Results

You can compare the thermal distribution of DrMOS solution with discrete solution.



For thermal distribution on board, you can change point of sight: top side, bottom side, front side and back side.





Display the temperatures of each components.

8-12. DrMOS Design Summary

View the summary of a simulation by “DrMOS Performance Analyzer”. As well as “Back Designer”, you can download the page by PDF format and BOM by Excel format.